

## PHARMACOLOGICAL EFFICACY OF *TRICHODESMA INDICUM* (LINN) R. BR., IN FOLK MEDICINE – AN UPDATED REVIEW

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Received: 23 December 2017, Revised and Accepted: 22 January 2018

### ABSTRACT

The medicinal knowledge of herbal plants plays a predominant role in finding new sources of drugs in pharmaceuticals. The plant *Trichodesma indicum* (Linn) R. Br. is a significant constituent of Boraginaceae family with prominent records in conventional folk medicine. The diverse uses of the entire plant parts are being widely studied by *in vitro* and *in vivo* experimental methods. The present work is aspired to provide a biological evaluation of the plant that has been explored so far on various parts of the plant such as roots, leaves, and seeds. It also aims to provide a scientific support to the medicinal properties of the various phytoconstituents that are isolated from the plant. Hence, the present review is a comprehensive literature analysis of chemistry, ethanol-pharmacology and the therapeutic uses of *T. indicum*.

**Keywords:** Boraginaceae, Ethanol-pharmacology, Folk medicine, Phytoconstituents, *Trichodesma indicum*.

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### INTRODUCTION

*T. indicum* (Linn) R.Br. is generally known as Indian Borage and belongs to Boraginaceae family which is a major group of angiosperms. In Tamil, it is known as Adhapushpi that is flowers are bent downward. The plant is found as a weed throughout the greater parts of India and stony dry wastelands of Pakistan. In Pakistan, it has been found at low altitude in Karachi, Sindh, Balochistan, Chitral, Swat, Hazara, Jhelum, Dhamial, the Rawalpindi hills, Poonch, and Kashmir [1]. Later it has been distributed in many south Asian regions such as Bhutan and Burma [2].

#### Description of the plant

It is a hispid, erect or diffuse annual herb with single pale blue flowers with hairs springing from tubercles. The leaves are stalkless, opposite, lanceolate, 2–8 cm long pointed at the tip and heart-shaped at the base. The flowers occur singly in the axils of the leaves. The sepal tube (calyx) is a green hairy and 1–13 cm long with pointed tubes. The fruit is ellipsoid and is enclosed by the calyx. The plant is acrid, bitter in taste. The aerial part of the plant was shown in Fig.1.

In herbal medicinal jargon, it is thermogenic, emollient, alexeteric, anodyne, carminative, depurative, febrifuge, and pectoral.

#### LANDMARKS OF *T. INDICUM* IN FOLK MEDICINE

The plant *T. indicum* has a good medicinal record in folk medicine curing various diseases. Its traditional uses are extensively summarized in Table 1 [3-13].

#### PHYTOCONSTITUENTS

A variety of bioactive constituents were reported to be present in the plant *T. indicum* [14-16]. The main phytoconstituents that are isolated from the plant are hexacosane,  $\alpha$ -amyrin, lupeol [17], nonsteroidal compounds [18], and fatty constituents [19]. n-Decyl laurate, n-tetradecanyl laurate, n-nonacosanyl palmitate, stigmast-5-en-3 $\beta$ -ol-21(24)-olide, n-pentacos-9-one, n-dotriacont-9-one-13-ene, Stigmast-5-en-3 $\beta$ -ol-23-one and lanast-5-en-3 $\beta$ -D-glucopyranosyl-21 (24)-olide were isolated from ethanol extract of *T. indicum* [20]. The fatty acids-oleic, linoleic, palmitic, stearic, and linolenic acid were also identified and isolated from the seed oil [21]. The data are tabulated in Table 2. The presence of alkaloids in the plant was also confirmed in our previous study [22].

### PHARMACOLOGICAL STUDIES

#### Antidiarrheal potential

The decoction obtained from the roots of *T. indicum* is generally ingested for curing diarrhea, dysentery, and fever which is an Indian habitual medicinal treatment. To evaluate the traditional claims, a study was undertaken by Behera *et al.* [3] with several animal models. The ethanol extract of the roots was utilized in the study and found the inhibition of the castor oil-induced diarrhea and decreased propulsion of charcoal meal through the gastrointestinal tract. The castor-oil induced small intestinal fluid accumulation was also reduced. The results obtained substantiate this herbal remedy of the plant as a specific treatment for diarrhea in folk medicine [3].

#### Anti-inflammatory activity

The anti-inflammatory activity of *T. indicum* was assessed against edema produced by carrageenan, dextran, histamine, and serotonin and against the formation of granulation tissues by cotton pellets in rats. The effect was compared with the activity of indomethacin, cyproheptadine, and dexamethasone against different types of inflammation.

The chloroform extract at doses of 50, 100, and 200 mg/kg exhibited significant anti-inflammatory activity in acute and chronic inflammatory models ( $p < 0.001$ ). At 200 mg/kg, the extract showed maximum inhibition of 48.12% in carrageenan-induced rat paw edema while the standard indomethacin inhibited it by 54.32% after 3 h of carrageenan injection. The extract of the specific concentrations (50, 100, and 200 mg/kg) significantly and dose-dependently inhibited Dextran, histamine, and serotonin-induced rat paw edema compared with control group (vehicle treated). In the chronic inflammatory model, the extract inhibited the granuloma weight by 15.42% and 21.2%, respectively, whereas the indomethacin and dexamethasone inhibited by 29.29% and 34.13%, respectively. The experimental results confirmed the anti-inflammatory activity of the extract at the tested dose levels [22].

#### Antitussive potential on SO<sub>2</sub>-induced cough reflex in mice

A study was carried out by Srikanth *et al.*, to investigate the whole plant of *T. indicum* R.Br on sulfur dioxide-induced cough reflex using Swiss albino mice. The methanol extract of the plant has demonstrated significant inhibition ( $p < 0.001$ ) in the frequency of a cough in all the tested doses when compared with untreated control group. The effect persisted up to 90 min of its oral administration and is comparable

Table 1: Usage of *T. indicum* plant parts in folk medicine

S.No	Plant part used	Uses in folk medicine	Place of use	References
1	Roots	To reduce swelling To cure body ache and anasarca	Chota Nagpur, India Kandhamal district, Orissa	[1] [3]
2.	Leaves	Healing of cuts, wounds, and bleeding	Kandhamal district, Orissa, and various places in Tamil Nadu, India	[3-5]
3.	Fresh leaves	To cure stomach upset and dysentery to children	Tiruchirappalli, Tamil Nadu, India	[5-7]
4.	Leaves and roots	To cure tumor, snake bite, and Urinary diseases	Chhattisgarh, India	[8-10]
5.	Whole plant	Pain healing in joints	Marginal district, Orissa, India	[12]
6.		For indigestion and to kill intestinal worms in cattle	Abbottabad district, North-West Frontier province, Pakistan	[11]
7.		To cure Influenza and cough	Nara desert, Pakistan	[13]

*T. indicum*: *Trichodesma indicum*

Table 2: Phytoconstituents isolated from *T. indicum*

S. No	Category of phytochemicals	Constituents present
1.	Terpenoids	$\alpha$ -amyrin, Lupeol
2.	Fatty acids and esters	Oleic acid, linoleic acid, palmitic acid, stearic acid, linolenic acid, n-decyl laurate, n-tetradecanyl laurate, n-nonacosanyl palmitate, stigmast-5-en-3 $\beta$ -ol-21 (24)-olide, and lanast-5-en-3 $\beta$ -D-glucopyranosyl-21 (24)-olide [18,19]
3.	Alkaloids	Monocrotaline, supinine [13-15]
4.	Aliphatic hydrocarbons and ketones	Hexacosane, n-pentacos-9-one, n-dotriacont-9-one-13-ene
5.	Steroidal compounds	Stigmast-5-en-3 $\beta$ -ol-23-one

*T. indicum*: *Trichodesma indicum*



Fig. 1: *Trichodesma indicum* Linn. R. Br. plant

to that of the standard drug (codeine phosphate). In conclusion, the results of the study provided pharmacological evidence in support of folklore claim as antitussive agent [23].

#### Antispasmodic and lipoxygenase inhibitory effect

According to the study conducted by Taous Khan *et al.*, in the evolution of the possible antispasmodic and lipoxygenase inhibitory activity of medicinal plants [24], *T. indicum* Linn. R.Br extract was tested on the isolated rabbit jejunum. The extract made a reduction in spontaneous and acetyl-induced contractions. It inhibited the intestinal contractions by 78% at 5 mg/ml. The extract showed a good to excellent lipoxygenase inhibitory activity (64.5%) on the tested enzyme [24].

#### ENZYME INHIBITION ACTIVITY

The ethanol extract of the plant was screened for enzyme inhibition activities against Urease and  $\alpha$ -chymotrypsin enzymes. Urease

activity was determined by measuring ammonia production using the indophenols method [25]. The  $\alpha$ -chymotrypsin inhibitory activity was performed by the method described by Cannel *et al.* [26] and found that the extract has significant inhibition activity [27].

#### ANTIMICROBIAL EFFECT

Bovine mastitis is one of the most prevalent diseases in dairy cattle among the dairy farms in Tamil Nadu. Therefore, an analysis on antibacterial activity of plant was carried out *in vitro* mode by the agar disc diffusion method. Aqueous and methanol extracts were used at two different concentrations (100 and 200 mg/ml). It was found to have the moderate antimicrobial activity, and the extracts did not show any activity against *Klebsiella pneumoniae* [28]. Further *in vitro* antimicrobial potential of ethanol extract of the plant root was also carried out along with its isolated compounds n-decyl laurate, n-tetradecanyl laurate, n-nonacosanyl palmitate, stigmast-5-en-3 $\beta$ -ol-21(24)-olide, n-pentacos-9-one, n-dotriacont-9-one-13-ene, stigmast-5-en-3 $\beta$ -ol-23-one and lanast-5-en-3 $\beta$ -D-glucopyranosyl-21 (24)-olide [20]. The extract exhibited potent growth inhibitory activity against *Staphylococcus aureus*, *Bacillus Subtilis*, and *Candida albicans* with a minimum inhibitory concentration (MIC) value of 19.2  $\mu$ g/ml. Among all the isolated compounds, lanast-5-en-3 $\beta$ -D-glucopyranosyl-21(24)-olide displayed strongest antibacterial activity against *S. aureus* with MIC value of 2.4  $\mu$ g/ml. The results obtained provide ground basis for the potential use of the ethanol extract of *T. indicum* root as well as the some of the isolated compounds in the treatment of infections associated with the studied microorganisms [20].

The effective resistivity against microorganisms of the plant was also identified by Saboo *et al.*, against *B. subtilis*, *S. aureus*, *Balantidium coli*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, *C. albicans*, *Aspergillus flavus*, and *Aspergillus niger* by disc diffusion method [29].

#### PHYTOTOXIC AND INSECTICIDAL ACTIVITY

To find some new natural sources of pesticides from botanical origin, crude extract of *T. indicum* R.Br, collected from Pakistan was investigated

on the exploration of phytomedicinal and agrochemical potentials. The insecticidal activity was tested against *B.Pisorum*, *Tribolium castaneum*, and *Rhyzopertha dominica*. The extract showed excellent insecticidal activity against *R. dominica* and caused 80% and 40% mortality of these species, respectively. It is, hence, concluded that *T. indicum* shows a considerable insecticidal activity, especially against *R. dominica* and *B. pisorum*. Therefore, it could serve as a new source of bioinsecticide for products when stored for a prolonged period and also as an effective pest control in the agricultural field.

Further, in the analysis of ethanol extract of the plant against *Lemna minor*, the plant showed a good inhibitory activity of growth of *L. minor* by 60% at higher concentration (500 µg/ml). At low concentration of 50 µg/ml, a weak inhibitory activity was observed (20%). Therefore, it has been concluded that ethanol extract showed a tremendous phytotoxic activity against *L. minor*. Thus, the study recommended that the plant can be utilized as a natural herbicide and could be a rich source of bioactive agrochemical [30].

#### ANALGESIC AND ANTIPYRETIC POTENTIAL

The possible analgesic and antipyretic potential of the plant were studied using several experimental models. The analgesic activity was determined in chemicals (acetic acid and formalin) as well as thermal (tail immersion) pain models in mice using classical standard drugs. The ethanol extract at doses of 100, 200, and 400 mg/kg exhibited a significant ( $p < 0.001$ ) inhibition of acetic acid-induced abdominal constrictions in mouse. In the tail immersion models, the extract (400 mg/kg) showed a significant increase ( $p < 0.001$ ) in pain threshold to the meal stimulus and also in both the phase (early and late phase) of the hyper analgesic mode of formalin test. It also produced a dose-related fall in rectal temperature in rat for up to 3 h after its administration. The experimental results suggest that the analgesic effect of the extract may be due to inhibition of the synthesis and/or liberation of inflammatory mediators. The extract also had a significant effect in tail immersion test. Centrally acting analgesic drugs elevate pain threshold of animals toward heat. The effect of the extract on this pain models indicates that it may be centrally acting.

Drugs that are acting primarily on the central system will inhibit both phases (early and late phases) equally while peripherally acting drugs inhibit the late phase. The ethanol extract of the plant *T. indicum* inhibited both the phases of formation induced pain with a more potent effect on the second than the first phase. Therefore, it showed a potent activity on both acetic acid-induced abdominal constrictions and tail immersion test.

Pyrogen, an induced fever substance includes oxygenous pyrogen and endogenous pyrogen. Analgesic and antipyretic activities are commonly mentioned as characteristics of drugs which have an inhibitory effect on prostaglandin biosynthesis. The yeast induced pyrexia in rat model was, therefore, employed to investigate the antipyretic activity of the extract. The extract was found to exert a significant lowering of body temperature, and its effect was similar to that of aspirin (standard drug). The results seem to support the view that the plant has some influence on prostaglandin biosynthesis because prostaglandin is believed to be the regulator of body temperature. Therefore, these results when taken together lead us to conclude that ethanol extract possesses a significant analgesic and antipyretic activity in several animal models at the dose levels examined [31].

#### ANTIMITOTIC AND ANTIPROLIFERATIVE ACTIVITY

The antimitotic and antiproliferative effects are important *in vitro* assays for the screening of anticancer compounds. In the study conducted by the Saboo *et al.*, mitotic index of the extracts clearly indicates the efficiency of the plant in the inhibition of cancer cell growth by affecting microtubules. The observed antiproliferative effect may be due to the inhibition of cell growth during the cell cycle, as they reduce the rate

of cell division by preventing the entry of the cell into the prophase and subsequent phases, which accredited the results of antimetabolic and antiproliferative study [32]. In Chhattisgarh state, tribal people utilize the plant for the treatment of breast cancer [9]. Breast cancer is one of the predominant disease-causing huge life loss of women every year globally [33]. Based on that, our earlier study was carried out to provide a scientific support by analyzing the cytotoxic activity of the plant. The chloroform and ethanol extracts of the plant were analyzed and were found a stronger activity with ethanol extract against breast cancer cell line (MCF-7), cervical cancer cell line (He-La) and laryngeal epithelial carcinoma cell line (HEp2). The results obtained are correlated its use in folk medicine in the treatment of cancer [34].

#### ANTI-DIABETIC ACTIVITY

In recent trends, herbal products trigger the search of biologically active compounds as the complementary and alternative medicine for diabetes mellitus. Anti-diabetic activity of the plant was examined in both *in vitro* amylase assay and *in vivo* streptozotocin (STZ)-nicotinamide induced Type 2 diabetic rats by Narendra *et al.* [35]. It has been identified that methanolic extract of the plant leaves has moderate  $\alpha$ -amylase inhibitory activity ( $IC_{50} = 91.3 \mu\text{g/ml}$ ). Almost all the tested extracts prominently reduces blood glucose levels in STZ-nicotinamide induced diabetic rats. The methanolic extract has shown an estimable decrease of blood glucose level ( $p < 0.01$ ) along with glibenclamide. The results confirmed the anti-diabetic property of the plant extract against Type 2 diabetes mellitus [35].

#### CONCLUSION

*T. indicum* is a weed plant which is now explored as a prominent herb and become an inevitable one in the medicinal field due to its extensive usage. The rural people of India and Pakistan are following the traditional methodology of the plant in curing various diseases which are overviewed in this manuscript. The various pharmaceutical and pharmacological analysis of the plant that is carried out is the substantiation for its importance in the herbal medicinal field. Even then, it is still treated as a scientifically un-investigated plant as further clinical trials and isolation of more phytoconstituents are yet to be carried out. The present review hence reveals the full therapeutic potential of this plant and invites the further researches to provide a platform establish it as a standard drug in the pharmaceutical industry.

#### CONFLICTS OF INTEREST

The author has no conflict of interest.

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